

### **REMARKS**

The Office Action dated December 27, 2007 has been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

Claims 1-17 and 20-29 are currently pending in the application. Claims 1-17 and 21-29 have been amended to more particularly point out and distinctly claim the subject matter of the invention. No new matter has been added. Claims 1-17 and 20-29 are respectfully submitted for consideration.

Claims 1-17 and 20-21 were objected to because of informalities. Specifically, the Office Action objected to the term “capable of communicating” as being optional. The claims have been amended to replace “capable of” with “configured to.” As such, Applicants submit that this objection is rendered moot.

Claims 26 and 27 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention. In particular, the Office Action asserted that the application allegedly does not provide support for the means recitations in the claims. This rejection is respectfully traversed for at least the following reasons.

Claim 26 recites, in part, means for communicating data within the first tier, and means for communicating data with the second tier. Claim 27 recites similar limitations but from the perspective of the second tier sink node. Applicants submit that the specification provides support for these limitations of the claims.

For example, page 10, lines 5-16 of the specification, discusses how traffic flows between nodes in the network. More specifically, this section of the specification provides that “[s]ink nodes located in the area covered by one sink become connected on the mesh tier when a path of mesh nodes is available between them. In this mesh network the traffic flows from one node to another seeking the optimal route to the receiver” (Specification, page 10, lines 9-13). Additionally, as illustrated in Fig. 1 of the present application, it is clear that the nodes of the network are connected via links and are in communication with one another. Fig. 1 shows that a sink node may communicate with other nodes on the same tier, as well as communicate with sink nodes in other tiers (Fig. 1, nodes 12-S, 14-S, and 16-S). Accordingly, the specification clearly shows that the sink nodes may communicate data within their tier and communicate data with sink nodes in other tiers.

Furthermore, pages 32-43 of the specification provide a further detailed discussion of the manner in which nodes may communicate data. These sections of the specification describe how the nodes may communicate via multi-casting or uni-casting (see Specification, page 32, lines 19-22, and Figs. 17-19). Additionally, the specification provides that the sink node may transmit and receive other nodes control packets (see Specification, page 33, lines 5-10, see also Figs. 20 and 24). Although the specification does not explicitly state “means for communicating,” Applicants submit that it is inherent that the sink node include some structure or means for communicating with other nodes. Moreover, a person of ordinary skill in the art would understand that a sink node must

include at least one means for communicating or transmitting data to other nodes. Therefore, Applicants respectfully submit that the specification provides support for the means recitations in claims 26 and 27. Applicants respectfully request that this rejection be withdrawn.

The Office Action also objected to the drawings as allegedly not showing every feature of claims 26 and 27. This rejection is respectfully traversed for at least the following reasons.

As discussed above, Fig. 1 illustrates that the nodes of the network are connected via links and are in communication with one another. Fig. 1 shows that a sink node may communicate with other nodes on the same tier, as well as communicate with sink nodes in other tiers (Fig. 1, nodes 12-S, 14-S, and 16-S). In addition, Figs. 17, 20, and 24 illustrate the nodes of the network and their interconnections, according to other embodiments of the invention. Further, as mentioned above, given that the nodes are linked together in order to communicate data, as illustrated in Figs. 1, 17, 20, and 24, it is inherent that some type of means for communicating be provided in order for traffic to move between nodes. Therefore, Applicants respectfully submit that at least Figs. 1, 17, 20, and 24 illustrate the elements of claims 26 and 27. Accordingly, Applicants respectfully request that the objection to the drawings be withdrawn.

Claims 1, 5, 6, 15, 16, 20-24, and 26-29 were rejected under 35 U.S.C. §102(e) as being anticipated by Haas (U.S. Patent No. 6,304,556). This rejection is respectfully traversed for at least the following reasons.

Claim 1, upon which claims 2, 3, 4, and 21 are dependent, recites a system including a first-tier mesh formed of a plurality of first-tier nodes, each of the first-tier nodes of the plurality of first-tier nodes configured to communicate data within the first tier with at least selected others of the first-tier nodes, at least one of the first-tier nodes forming a first-tier sink node. The system also includes at least a second-tier mesh formed of a plurality of second-tier nodes, each of the second-tier nodes of the plurality of second-tier nodes configured to communicate data within the second tier with at least selected others of the second-tier nodes, at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further configured to communicate with the first-tier sink node of the first-tier mesh. The system is configured to provide radio communication of data therein

Claim 5, upon which claims 6-7 are dependent, recites a system including a first-tier mesh formed of a plurality of first-tier nodes, each of the first-tier nodes of the plurality of first-tier nodes configured to communicate data within the first tier with at least selected others of the first-tier nodes, at least one of the first-tier nodes forming a first-tier sink node. The system also includes at least a second-tier mesh formed of a plurality of second-tier nodes, each of the second-tier nodes of the plurality of second-tier nodes configured to communicate data within the second tier with at least selected others of the second-tier nodes, at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further configured to communicate with the first-tier sink node of the first-tier mesh. The first-tier mesh comprises an ad-hoc mesh which exhibits

an ad-hoc configuration and an ad-hoc number of first-tier nodes. The system is configured to provide radio communication of data therein.

Claim 15, upon which claims 16-17 are dependent, recites a system including a first-tier mesh formed of a plurality of first-tier nodes, each of the first-tier nodes of the plurality of first-tier nodes capable of communicating data within the first tier with at least selected others of the first-tier nodes, at least one of the first-tier nodes forming a first-tier sink node. The wireless access network also includes at least a second-tier mesh formed of a plurality of second-tier nodes, each of the second-tier nodes of the plurality of second-tier nodes capable of communicating data within the second tier with at least selected others of the second-tier nodes, at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further capable of communicating with the first-tier sink node of the first-tier mesh. The at least one of the first-tier nodes forming the first-tier sink node comprises a first first-tier node forming a first first-tier sink node and at least a second first-tier node forming a second first-tier sink node, wherein the at least one of the second-tier nodes forming the second-tier sink node comprises a first second-tier node forming a first second-tier sink node and at least a second, second-tier node forming a second second-tier sink node, the first first-tier sink node capable of communicating with the first second-tier sink node, the second first-tier sink node capable of communicating with the second second-tier sink node, and the first and second second-tier sink nodes, respectively, capable of communicating therebetween. The system is configured to provide radio communication of data therein

Claim 20 recites a method including forming a wireless access network providing for communication therein. The method further includes forming a first-tier mesh of a plurality of first-tier nodes, each of the first-tier nodes capable of communicating data within the first tier with at least selected others of the first-tier nodes, at least one of the first-tier nodes forming a first-tier sink node. The method also includes forming a second-tier mesh of a plurality of second-tier nodes, each of the second-tier nodes of the plurality of second-tier nodes capable of communicating data within the second tier with at least selected others of the second-tier nodes, at least one of the second tier nodes forming a second-tier sink node further capable of communicating with the first-tier sink node of the first-tier mesh formed during the operation of forming the second-tier mesh.

Claim 22, upon which claim 23 is dependent, recites an apparatus comprising at least one first-tier node, wherein the at least one first-tier node is configured to form a first-tier mesh, and the apparatus is configured to communicate data within the first tier with at least selected others of the at least one first-tier node and to communicate data with a second-tier sink node of a second-tier network.

Claim 24, upon which claim 25 is dependent, recites an apparatus comprising at least one second-tier nodes, wherein the at least one second-tier node is configured to form a second-tier mesh, and the apparatus is configured to communicate data within the second tier with at least selected others of the at least one second-tier node and to communicate data with a first-tier sink node of a first-tier mesh.

Claim 26 recites an apparatus comprising at least one first-tier node. The at least one first-tier node is configured to form a first-tier mesh. The apparatus further includes means for communicating data within the first tier with at least selected others of the at least one first-tier node, and means for communicating data with a second-tier sink node of a second-tier network.

Claim 27 recites an apparatus comprising at least one second-tier node. The at least one second-tier node is configured to form a second-tier mesh. The apparatus further includes means for communicating data within the second tier with at least selected others of the at least one second-tier node, and means for communicating data with a first-tier sink node of a first-tier mesh.

Claim 28 recites a method including forming a first-tier mesh using at least one first-tier nodes, communicating data within the first tier with at least selected others of the at least one first-tier nodes, and communicating data with a second-tier sink node of a second-tier network.

Claim 29 recites a method including forming a second-tier mesh using at least one second-tier nodes, communicating data within the second tier with at least selected others of the at least one second-tier nodes, and communicating data with a first-tier sink node of a first-tier mesh.

As will be discussed below, Haas fails to disclose or suggest all of the elements of the claims, and therefore fails to provide the features discussed above.

Haas discloses two network communication protocols, one for routing and one for mobility management, that are suited for use with ad-hoc networks. The routing protocol is a proactive-reactive hybrid routing protocol that limits the scope of the proactive procedure to the node's local neighborhood. Routing zones are defined for each node that include nodes whose distance from the subject node in hops is at most some predefined number, referred to as the zone radius. Each node is required to know the topology of the network within its routing zone only. The reactive procedure is limited during route discovery to queries of only those nodes located on the periphery of routing zones. In this manner, the queries hop across nodes in distances of zone radius, thus limiting the scope of the reactive procedure. The zone radius is preferably adjustable to accommodate different and differing network topologies and network operational conditions in the most efficient manner. The mobility management protocol relies on some network nodes assuming the mobility management function. In this scheme, each network node is "associated" with one or more mobility management nodes. The mobility management nodes form a virtual network which is embedded within the actual ad-hoc network. Each mobility management node knows the location of all nodes within its zone, and communicates this information to any other mobility management node that requests it.

Applicants respectfully submit that Haas fails to disclose or suggest all of the elements of the present claims. For instance, Haas fails to disclose or suggest "at least one of the first-tier nodes forming a first-tier sink node," or "at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further configured to

communicate data with the first-tier sink node of said first-tier mesh,” as recited in claims 1, 5, 8, 11, 15, and 20. Furthermore, Haas does not disclose or suggest “a first-tier sink node comprising at least one first-tier nodes,” as recited in claim 22 or “a second-tier sink node comprising at least one second-tier nodes,” as recited in claim 24, and the similar limitations recited in claims 26-29.

According to embodiments of the present invention, a multi-tiered mesh network is provided. Specifically, the network may include an ad-hoc mesh tier (AMT) 12, a pre-configured mesh tier (PMT) 14, and a PTP tier 16. A mesh network is built around sink nodes by adding mesh nodes. For instance, the AMT 12 includes sink nodes 12-S and mesh nodes 12-M. The PMT 14 includes sink nodes 14-S and mesh nodes 14-M. The PTP tier 16 includes sink nodes 16-S and mesh nodes 16-M. Sink nodes located in the area covered by one sink become connected on the mesh tier when a path of mesh nodes is available between them. In this mesh network, the traffic flows from one node to another seeking the optimal route to the receiver even though the major part of the traffic tends to come or go to the Internet outside the radio network. Therefore, the traffic flow in a mesh network will be mainly from and towards sinks (Specification, page 10, lines 3-16 and Fig. 1).

Haas, on the other hand, does not disclose or suggest the first tier sink nodes and second tier sink nodes of the present invention. Rather, Haas discloses “a plurality of network nodes 22 that are partitioned into four clusters 24, 26, 28 and 30, each of which forms a corresponding tier-1 network. In each cluster, one node labeled CH1, CH2, CH3

and CH4, respectively, is chosen to be a cluster head. The cluster heads thus form a tier-2 network 32” (Haas, Column 8, lines 40-45). Accordingly, the second tier is just formed of cluster heads from the first tier. As such, Haas only discloses a plurality of tier-1 nodes, some of which (the cluster heads) also form tier-2. Therefore, Haas does not disclose “at least one of the first-tier nodes forming a first-tier sink node,” and “at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further configured to communicate data with the first-tier sink node of said first-tier mesh.” Accordingly, Haas fails to disclose or suggest all of the elements of claims 1, 5, 15, 20, 22, 24, and 26-29.

Claims 6, 16, 21, and 23 are dependent upon claims 5, 15, 20, and 22, respectively. As such, claims 6, 16, 21, and 23 should be allowed for at least their dependence upon claims 5, 15, 20, and 22, and for the specific limitations recited therein.

Claims 2, 3, 8, 9, 11-13, 17, and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Haas in view of Liu (U.S. Patent No. 6,980,537). This rejection is respectfully traversed for at least the following reasons.

Claim 8, upon which claims 9-10 are dependent, recites a system which includes a first-tier mesh formed of a plurality of first-tier nodes, each of the first-tier nodes of the plurality of first-tier nodes configured to communicate data within the first tier with at least selected others of the first-tier nodes, at least one of the first-tier nodes forming a first-tier sink node. The system also includes at least a second-tier mesh formed of a plurality of second-tier nodes, each of the second-tier nodes of the plurality of second-tier

nodes capable of communicating data within the second tier with at least selected others of the second-tier nodes, at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further configured to communicate with the first-tier sink node of the first-tier mesh. The second-tier mesh comprises a pre-configured mesh which exhibits a fixed configuration and a fixed number of second-tier nodes. The system is configured to provide radio communication of data therein.

Claim 11, upon which claims 12-14 are dependent, recites a system including a first-tier mesh formed of a plurality of first-tier nodes, each of the first-tier nodes of the plurality of first-tier nodes configured to communicate data within the first tier with at least selected others of the first-tier nodes, at least one of the first-tier nodes forming a first-tier sink node. The system further includes at least a second-tier mesh formed of a plurality of second-tier nodes, each of the second-tier nodes of the plurality of second-tier nodes configured to communicate data within the second tier with at least selected others of the second-tier nodes, at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further configured to communicate with the first-tier sink node of said first-tier mesh, and a third-tier mesh formed of a plurality of third-tier nodes, each of the third-tier nodes of the plurality of third-tier nodes configured to communicate data with at least selected others of the third-tier nodes, at least one of the third-tier nodes forming a third-tier sink node. The system is configured to provide radio communication of data therein.

As will be discussed below, the combination of Haas and Liu fails to disclose or suggest all of the elements of the claims, and therefore fails to provide the features discussed above.

Haas is discussed above. Liu discloses a system and method for cluster formation within a communications network by utilizing network topology information to designate network nodes that are crucial for relaying traffic as cluster head nodes, while the remaining network nodes are designated as member nodes. Liu adjusts a node status packet transmission rate or interval between successive node status packet transmissions to facilitate cluster formation independent of network size and varying initial start times of network nodes. This cluster formation is utilized to form a three tier architecture for transmission or flooding of routing information from head node databases throughout the network.

Applicants respectfully submit that the combination of Haas and Liu fails to disclose or suggest all of the elements of the present claims. For example, Haas and Liu do not disclose or suggest “at least one of the first-tier nodes forming a first-tier sink node,” or “at least one of the second-tier nodes forming a second-tier sink node, the second-tier sink node further configured to communicate data with the first-tier sink node of said first-tier mesh,” as recited in claim 8 and similarly recited in claim 11. Liu, like Haas, does not disclose any elements which correspond to the sink nodes of the claimed invention. Accordingly, the combination of Haas and Liu fails to disclose these limitations of the claims.

Furthermore, the combination of Haas and Liu does not disclose or suggest “wherein said second-tier mesh comprises a pre-configured mesh which exhibits a fixed configuration and a fixed number of second-tier nodes,” as recited in claim 8. The Office Action cited Liu as allegedly disclosing this limitation of the claims (Office Action, page 7). However, Liu only discloses that the head nodes form a second tier 160 where each node within that tier is a head node (Liu, Column 14, lines 40-45). Liu fails to disclose or suggest that the “second-tier mesh comprises a pre-configured mesh which exhibits a fixed configuration and a fixed number of second-tier nodes,” as recited in claim 8. Therefore, the combination of Haas and Liu fails to disclose or suggest all of the elements of claim 8.

In addition, the combination of Haas and Liu fails to disclose or suggest “a third-tier mesh formed of a plurality of third-tier nodes, each of the third-tier nodes of the plurality of third-tier nodes configured to communicate data with at least selected others of the third-tier nodes, at least one of the third-tier nodes forming a third-tier sink node,” as recited in claim 11. The Office Action again took the position that Liu discloses this limitation of the claims (Office Action, page 8). Applicants respectfully disagree.

Liu merely discloses that “nodes 10(1)-10(11) of network 200 are initially within a first tier 150. Cluster formation is performed by the first tier nodes where nodes 10(3), 10(6) and 10(9) are designated as head nodes 14(3), 14(6) and 14(9). These head nodes form a second tier 160 where each node within that tier is a head node. The head nodes of tier 160 perform cluster formation as described above and node 14(6) is designated as

a super node 15(6). The super node forms a third tier 170” (Liu, Column 14, lines 37-45). Therefore, Liu teaches that some of the first tier nodes are designated as head nodes which form a tier of head nodes. One of the head nodes is then designated as a super node, which forms a third tier. As such, Liu discloses that one of the first tier nodes (i.e. 14(6)) is designated as a third tier. Liu, however, does not disclose or suggest “a third-tier mesh formed of a plurality of third-tier nodes,... at least one of the third-tier nodes forming a third-tier sink node,” as recited in claim 11. Moreover, Liu and Haas do not disclose or suggest a third-tier sink node for the reasons discussed above. Accordingly, the combination of Haas and Liu fails to disclose or suggest all of the elements of claim 11.

Claims 4 and 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over Haas in view of Acampora (U.S. Patent No. 6,751,455). This rejection is respectfully traversed for at least the following reasons.

Haas is discussed above. Acampora discloses a radio link management system for a home or office including an ad hoc network of agents wirelessly communicating among themselves, while clients wirelessly communicate with proximate agents. Control of the network may be centralized in a network controller integrated with an agent, or may be distributed upon the network of agents. Some of the agents, which may include an agent that is also the network controller, serve as a gateway device which connects to a worldwide communications network external to the home or office. Parameters for radio communication are allocated ad hoc in a manner which is client-dependent, and uses the

least power from the battery-powered client. The agents establish an ad-hoc network among themselves, with routing among and between the agents being both multi-hop and “minimum hop” to conserve bandwidth.

Claims 4 and 7 are dependent upon claims 1 and 5, respectively. As discussed above, Haas fails to disclose or suggest all of the elements of claims 1 and 5. Additionally, Acampora does not cure the deficiencies in Haas, as Acampora also fails to disclose or suggest the sink nodes of the present claims. Therefore, the combination of Haas and Acampora fails to disclose or suggest all of the elements of claims 4 and 7. Furthermore, claims 4 and 7 should be allowed for at least their dependence upon claims 1 and 5, and for the specific limitations recited therein.

Claims 10 and 14 were rejected under 35 U.S.C. §103(a) as being unpatentable over Haas in view of Liu, and further in view of Acampora. This rejection is respectfully traversed for at least the following reasons.

Claims 10 and 14 are dependent upon claims 8 and 11, respectively. As discussed above, Haas and Liu fail to disclose or suggest all of the elements of claims 8 and 11. Additionally, Acampora does not cure the deficiencies in Haas and Liu, as Acampora also fails to disclose or suggest the sink nodes of the present claims. Therefore, the combination of Haas and Acampora fails to disclose or suggest all of the elements of claims 10 and 14. Furthermore, claims 10 and 14 should be allowed for at least their dependence upon claims 8 and 11, and for the specific limitations recited therein.

For at least the reasons outlined above, Applicants respectfully submit that the cited prior art fails to disclose or suggest all of the elements of the claimed invention. These distinctions are more than sufficient to render the claimed invention unanticipated and unobvious. It is therefore respectfully requested that all of claims 1-17 and 20-29 be allowed, and this application passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicants' undersigned representative at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,



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